Small Business Innovation Research/Small Business Tech Transfer

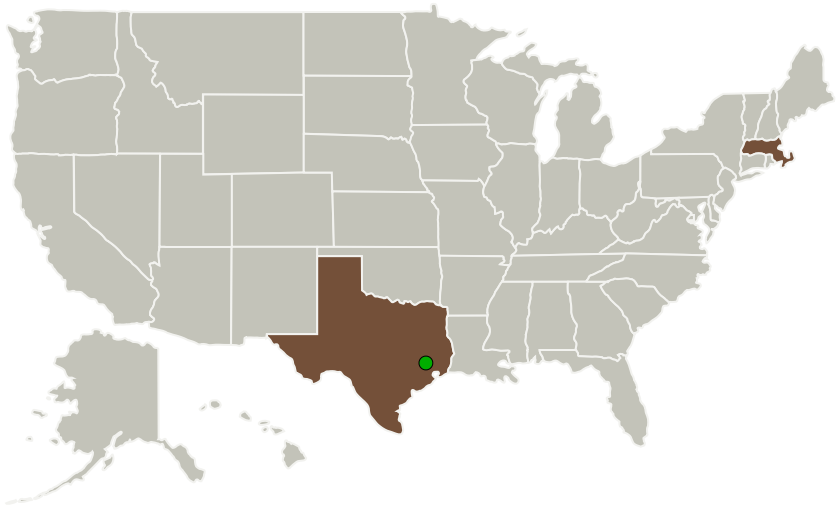
Variable Emissivity for Manned Spacecraft, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

Triton Systems is currently developing an unpowered, switchable emissivity film for application to spacecraft surfaces. We call our approach Phase Change Thermochromic Radiator (PCTR); it self-switches from low to high emissivity above a designed temperature setpoint, causing a surface in space to radiate heat only when it becomes too warm and conserving heat otherwise. Key to the operation of PCTR is the phase change material vanadium dioxide, integrated into a multilayer thin film structure to produce a device which is reflective over the 3-35 um IR band below a transition temperature Tc but strongly absorptive above Tc. PCTR has advantages over competing approaches to dynamic emissivity such as electrochromics, in that it requires no electrical drive power, is relatively simple to fabricate, and contains only stable, rugged, well understood materials. The proposed program will significantly upgrade the performance of PCTR to approach the system requirements of planetary exploration probes and landers, manned and unmanned. Performance targets include high emissivity of 0.9, low emissivity of 0.15, turndown ratio of at least 6:1 and potentially 10:1, and solar alpha 0.1 or less. These advances will be achieved by a new design approach using nanostructural enhancement. Fabrication methods will be developed which can be scaled up to produce 10's of square meters of film. Beyond thermal performance tests (turndown, etc.), key qualification tests include thermal cycling, vibration, peel tests, surface charge and life degradation.

Primary U.S. Work Locations and Key Partners



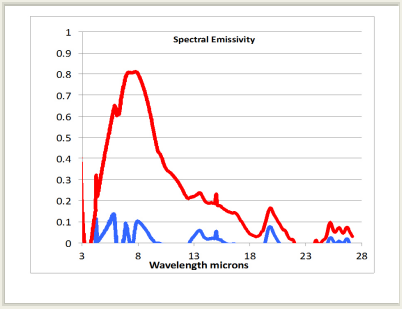


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Table of Contents

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Variable Emissivity for Manned Spacecraft, Phase I

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Organizations Performing Work	Role	Type	Location
Triton Systems Inc.	Lead Organization	Industry	Chelmsford, Massachusetts
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Massachusetts	Texas

Project Transitions

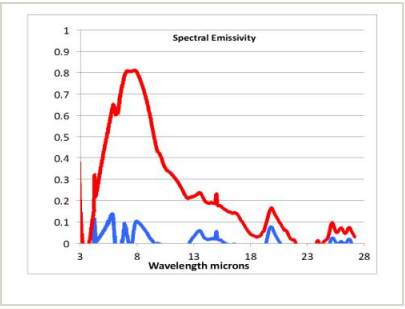
June 2016: Project Start

December 2016: Closed out

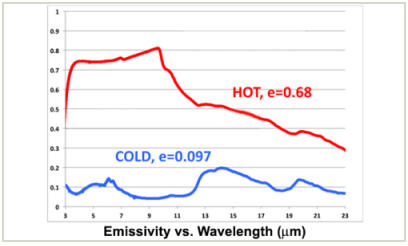
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139849)*

Images



Briefing Chart Image
Variable Emissivity for Manned Spacecraft, Phase I *(https://techport.nasa.gov/image/136324)*



Final Summary Chart Image
Variable Emissivity for Manned Spacecraft, Phase I Project Image *(https://techport.nasa.gov/image/132508)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Triton Systems Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

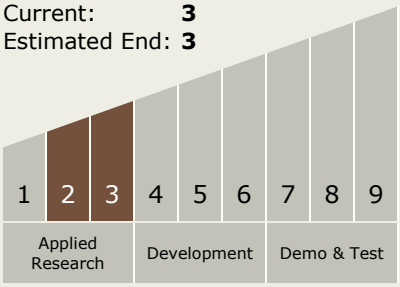
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Larry Domash

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.3 Heat Rejection and Storage

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System